

PATENT ABSTRACTS OF JAPAN

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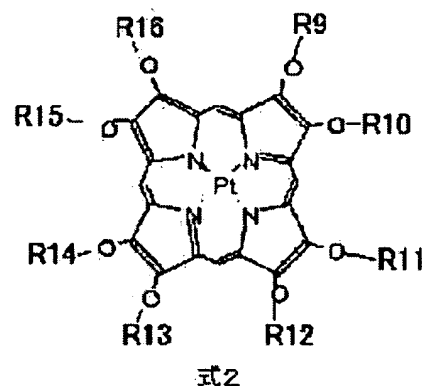
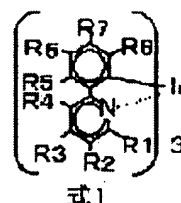
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KOMATSUZAKI AKIHIRO

(54) ORGANIC ELECTROLUMINESCENT ELEMENT

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an organic electroluminescent element which can emit light of high brightness by wet process.

SOLUTION: A doping agent 41 of a luminous layer 40 has its molecular structure to be expressed as formula 1 or formula 2. In formula 1, at least one of R1 to R8 denotes a substituent made of other than hydrogen and at the same time denotes hydrogen or any given substituent each independently, and/or may have an aromatic ring condensed at each of adjacent Rm (m is an integer of 1 or more and 4 or less) or adjacent Rn (n is an integer of 5 or more and 8 or less). In the formula 2, R9 to R16 denote hydrogen or any given substituent each independently.



LEGAL STATUS

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examiner's decision of rejection or application converted
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* NOTICES *

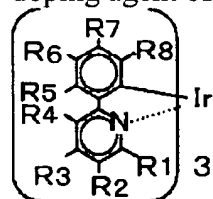
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1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

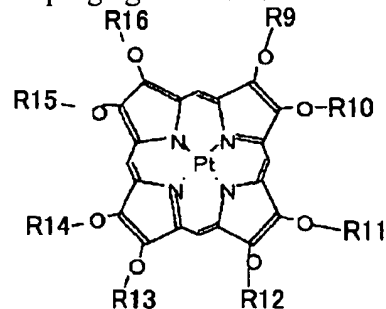
[Claim 1] It is formed between an anode plate layer and the two-electrodes layer of catholyte, it sets to the organic electroluminescent element possessing the luminous layer which has a host agent and the doping agent which emits phosphorescence, and the molecular structure of the doping agent of said luminous layer is [Formula 1].



(Hydrogen or the substituent of arbitration is shown independently, respectively. Among a chemical formula [-izing 1], while at least one of R1 thru/or the R8 shows the substituent which consists of other than hydrogen) or/and adjoining Rn (integer to which n changes from or more 5 eight or less either) which Rm(s) or (integer to which m changes from or more 1 four or less either) adjoins may be alike, respectively, it may set, and a ring may condense. The organic electroluminescent element which carries out and is characterized by what is shown.

[Claim 2] The substituent shown in R1 in said chemical formula [-izing 1] thru/or R8 is an organic electroluminescent element according to claim 1 characterized by consisting of an alkyl group or an alkoxy group.

[Claim 3] It is formed between an anode plate layer and the two-electrodes layer of catholyte, it sets to the organic electroluminescent element possessing the luminous layer which has a host agent and the doping agent which emits phosphorescence, and the molecular structure of the doping agent of said luminous layer is [Formula 2].



(-- R9 thru/or R16 show hydrogen or the substituent of arbitration independently among a chemical formula [-izing 2], respectively.) -- ***** -- organic electroluminescent element characterized by what is shown.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the organic electroluminescent element in which luminescence by high brightness is possible.

[0002]

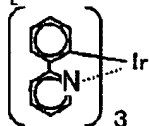
[Description of the Prior Art] Conventionally, it is formed by the multilayer laminated structure equipped with the luminous layer which contains the matter which emits phosphorescence by U.S. Pat. No. 6097147, and the organic electroluminescent element which raised luminous efficiency is known.

[0003] In this thing, since the so-called dry process using the vacuum evaporation process of the matter which emits phosphorescence on the occasion of laminating formation of the thin film which consists of a multilayer is adopted, a production process becomes complicated and the fault that improvement in productive efficiency is controlled arises.

[0004]

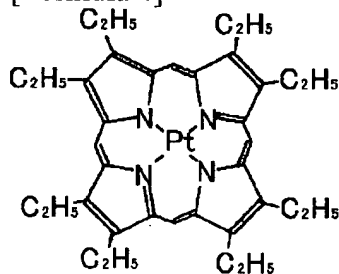
[Problem(s) to be Solved by the Invention] Then, [0005] generally used as a doping agent which emits phosphorescence although the thing which uses the luminescent matter in the state of a solution, and which adopts the so-called wet method is known on the occasion of formation of the above-mentioned multilayer laminating in order to avoid the fault in the above-mentioned dry process

[Formula 3]



[0006] The Tri (2 phenyl pyridine) iridium complex (it is also called the following Ir(ppy) 3.) shown in [-izing 3], and [0007]

[Formula 4]



[0008] Since the solubility to a solvent is generally small, the 2, 3, 7, 8, 12, 13, 17, and 18-OKUTA ethyl-21 platinum [H and 23H-] (II) porphyrin (it is also called Following PtOEP.)

shown in [-izing 4] has a limitation in increasing the concentration of the above-mentioned doping agent of the solution used with a wet method, and raising brightness.

[0009] In this invention, it is making into the technical problem to offer the organic electroluminescent element which can emit light for high brightness with a wet method in view of the above-mentioned trouble.

[0010]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, this invention shall be formed between an anode plate layer and the two-electrodes layer of catholyte, and the molecular structure of the doping agent of said luminous layer shall be shown as [-izing 1] or [-izing 2] in the organic electroluminescent element possessing the luminous layer which has a host agent and the doping agent which emits phosphorescence.

[0011] Since the doping agent shown as the above [-izing 1] or [-izing 2] has the relatively large solubility to a solvent, it can create the solution containing a comparatively high-concentration doping agent. For this reason, the luminous layer formed by the wet method using this solution will contain a comparatively high-concentration doping agent, and can obtain the organic electroluminescent element which can emit light for high brightness by this luminous layer.

[0012] Furthermore, when using the doping agent shown as [-izing 1], it is possible to make into an alkyl group or an alkoxyl group the substituent shown in R1 under [-izing 1] thru/or R8.

[0013]

[Embodiment of the Invention] Drawing 1 shows the basic structure of an organic electroluminescent element of having the component structure by which the laminating was carried out to the multilayer for the purpose of improvement in luminous efficiency. The component structure of an organic electroluminescent element is a multilayer laminated structure from which the laminating of each thin film layer of the electron hole transportation layer 20, the electronic block layer 30, a luminous layer 40, the electron hole block layer 50, and the electronic transportation layer 60 is carried out one by one, and it changes to the anode plate layer 10 formed on the substrate outside drawing between the two-electrodes layers of the anode plate layer 10 and catholyte 70, and a luminous layer 40 has the luminous layer doping agent 41 and the luminous layer host agent 42, and is constituted.

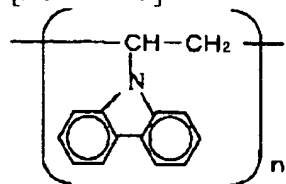
[0014] In the component structure shown by drawing 1, the transparent conductive matter formed in a transparence insulation base material like a glass substrate is used, and conductive polymers, such as inorganic conductivity matter, such as metals, such as conductive oxides, such as tin oxide, indium oxide, and a tin oxide indium (ITO), or gold, silver, and chromium, iodine copper, and copper sulfide, the poly thiophene, polypyrrole, and the poly aniline, etc. can be used for the anode plate layer 10 as the ingredient.

[0015] Moreover, when catholyte 70 is formed with the transparent ingredient, the anode plate layer 10 may be formed with an opaque ingredient.

[0016] Moreover, in the component structure shown by drawing 1, a simple substance or alloys, such as a lithium, sodium, a potassium, a rubidium, caesium, magnesium, calcium, strontium, barium, boron, aluminum, copper, silver, and gold, can be used for catholyte 70. Furthermore, they can also be used, carrying out the laminating of these. Moreover, it can also form with wet by the tetrahydro aluminate. In this case, especially as a tetrahydro aluminate used for catholyte 70, a lithium aluminum hydride, a hydrogenation aluminum potassium, hydrogenation aluminum magnesium, and hydrogenation aluminum calcium can be mentioned. In this, the lithium aluminum hydride is especially excellent in the electron injection nature to an electronic transportation layer.

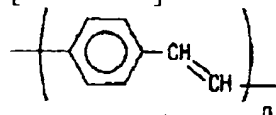
[0017] Moreover, the electron hole transportation layer 20 is a layer for conveying the electron hole poured in from the anode plate layer 10, and is an organic layer containing the electron hole transportability organic substance. As an example of the electron hole transportation **** organic substance, it is [0018].

[Formula 5]



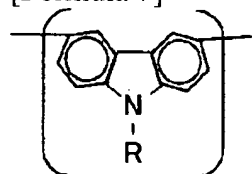
[0019] Pori (N-vinylcarbazole) (it is also called Following PVK.) shown in [-izing 5], [0020]

[Formula 6]



[0021] Pori (Para-phenylenevinylene) shown in [-izing 6], [0022]

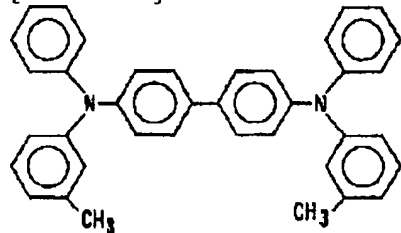
[Formula 7]



[0023] (The inside of a chemical formula [-izing 7] and R are substituents constituted from C, H, O, and N)

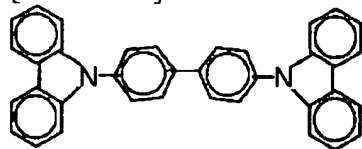
It is desirable to consist of macromolecules, such as the poly carbazole compound which repeats [-izing 7] and it has as a unit. Or [0024]

[Formula 8]



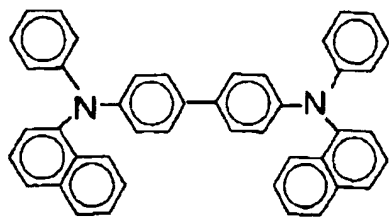
[0025] N shown in [-izing 8], N'-diphenyl-N, the N'-screw (3-methylphenyl) -1, the 1'-biphenyl - 4, 4'-diamine (it is also called Following TPD.), [0026]

[Formula 9]



[0027] The carbazole biphenyl (henceforth CBP) shown in [-izing 9], [0028]

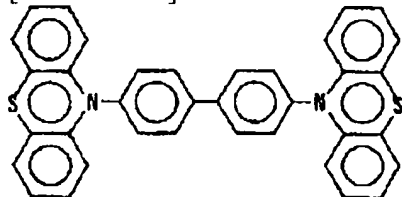
[Formula 10]



[0029] N shown in [-izing 10], N'-diphenyl-N, N'-screw (1-naphthyl) - 1, the 1'-biphenyl -4, 4'-diamine (henceforth NPD)

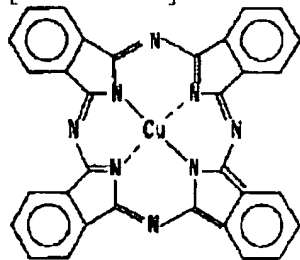
[0030]

[Formula 11]



[0031] The 4 and 4'-bis(10-phenothiazinyl) biphenyl shown in [-izing 11], [0032]

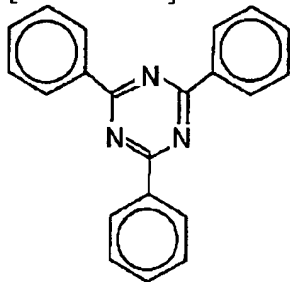
[Formula 12]



[0033] The kappa phthalocyanine shown in [-izing 12] is mentioned.

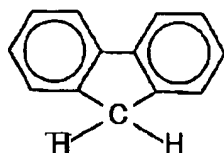
[0034] Moreover, the electronic block layer 30 is a layer for blocking an electron, in order that the electron poured in to the luminous layer 40 may protect passing to the anode plate layer 10 as it is from catholyte 70, and it consists of electronic block nature matter. As electronic block nature matter, it is the compound shown by [-izing 5], [-izing 6], [-izing 8], or [-izing 11], and [0035], for example.

[Formula 13]



[0036] 2, 4, 6-triphenyl which are shown in [-izing 13] - 1, 3, 5-triazole, [0037]

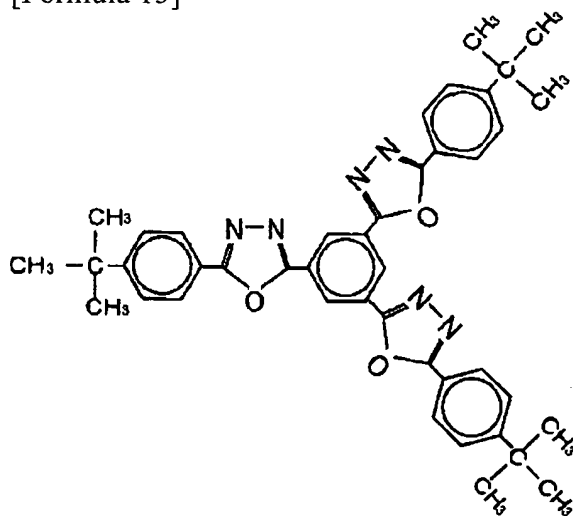
[Formula 14]



[0038] FUIOREN shown in [-izing 14] can be mentioned.

[0039] Moreover, since a luminous layer 40 has a doping agent 41 and the host agent 42 and homogeneity is made to distribute these doping agents 41 and the host agent 42, it is also possible to add a binder macromolecule. In case the electron hole and electron which were poured in, respectively recombine the host agent 42 in a luminous layer 40 from the anode plate layer 10 and catholyte 70, it is matter which activation is carried out and acts as an exciton, and it is [0040].

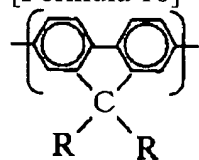
[Formula 15]



[0041] 1, 3, 5-Tori (5-(4-tert-buthylphenyl)- 1, 3, 4-OKISA diazole) phenyl (OXD-1 is said below.) which are shown in [-izing 15]

[0042]

[Formula 16]

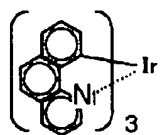


[0043] (R shows the substituent constituted from C, H, O, and N among a chemical formula [-izing 16].)

The poly fluorene compound which repeats [-izing 16] and it has as a unit is mentioned.

[0044] On the other hand, the doping agent 41 of a luminous layer 40 is Ir (ppy)₃ which is the matter which emits phosphorescence with the excitation energy of the exciton slack host agent 42, and is shown in [-izing 3], and [0045].

[Formula 17]



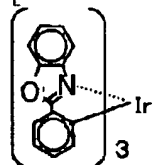
[0046]

[Formula 18]



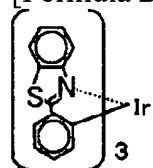
[0047]

[Formula 19]



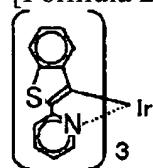
[0048]

[Formula 20]



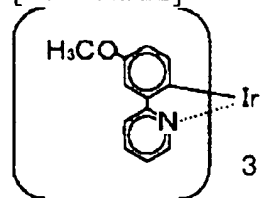
[0049]

[Formula 21]



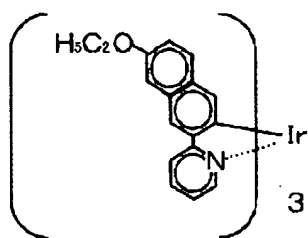
[0050]

[Formula 22]



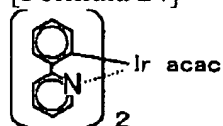
[0051]

[Formula 23]



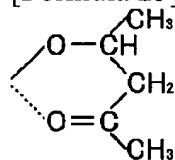
[0052]

[Formula 24]



[0053] (The inside of a chemical formula [-izing 24] and acac are [0054].)

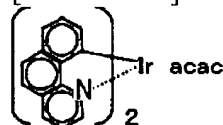
[Formula 25]



[0055] The functional group shown by [-izing 25] is shown. the following -- the same in the chemical formula shown in [-izing 26] thru/or [-izing 30].

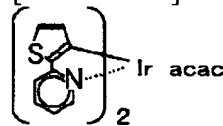
[0056]

[Formula 26]



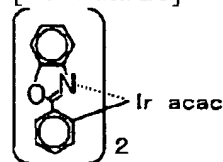
[0057]

[Formula 27]



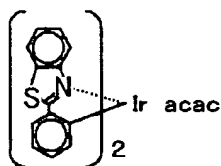
[0058]

[Formula 28]



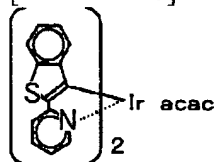
[0059]

[Formula 29]



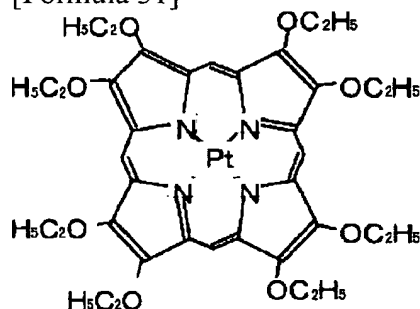
[0060]

[Formula 30]



[0061] PtOEP, [0062] which are shown in the iridium complex compound shown by [-izing 17] thru/or [-izing 24], [-izing 26], or [-izing 30], and [-izing 4]

[Formula 31]

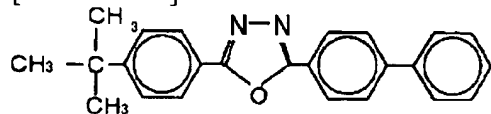


[0063] The 2, 3, 7, 8, 12, 13, 17, 18-OKUTA ethoxy-21H, and 23H-porphin platinum (II) shown in [-izing 31] can be mentioned.

[0064] As an example of the binder giant molecule which can be added to a luminous layer 40, moreover, polystyrene, A polyvinyl biphenyl, a polyvinyl phenanthrene, a polyvinyl anthracene, Polyvinyl perylene, Pori (ethylene-co-vinyl acetate), cis of polybutadiene, trans, Pori (2-vinyl naphthalene), A polyvinyl pyrrolidone, polystyrene, Pori (methyl methacrylate), Pori (vinyl acetate), Pori (2-vinylpyridine-co-styrene), The poly acenaphthylene, Pori (acrylonitrile-co-butadiene), Pori (benzyl methacrylate), Pori (vinyltoluene), Pori (styrene-co-acrylonitrile), Pori (4-vinyl biphenyl), a polyethylene glycol, etc. are mentioned.

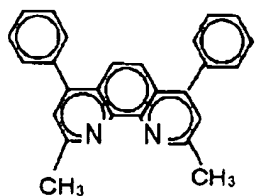
[0065] Moreover, the electron hole block layer 50 is a layer for blocking an electron hole, in order that the electron hole poured in to the luminous layer 40 may protect passing to catholyte 70 as it is from the anode plate layer 10, and it consists of electron hole block nature matter. As electron hole block nature matter, it is [0066], for example.

[Formula 32]



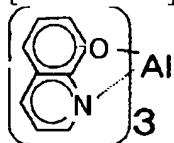
[0067] [-izing 32] shown 2-(4-biphenyl)-5-(4-tert-buthylphenyl)- 1, 3, and 4-OKISA diazole -- (-- it is also called Following PBD. []) -- 0068]

[Formula 33]



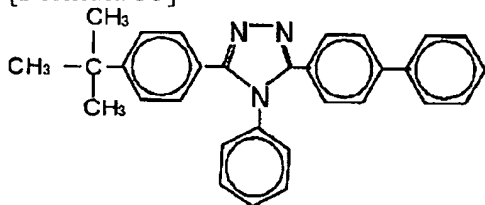
[0069] OXD-1, [0070] which are shown in the BASOKYU pro in (it is also called Following BCP.) shown in [-izing 33], and [-izing 15]

[Formula 34]



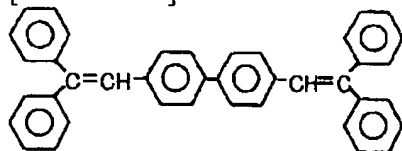
[0071] The tris(8-hydroxyquinoline)aluminium (it is also called the following Alq3.) shown in [-izing 34], [0072]

[Formula 35]



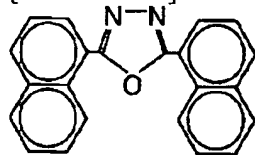
[0073] 3-(4-biphenyl)-5-(4-tert-buthylphenyl)-4-phenyl shown in [-izing 35] - 1, 2, 4-triazole (henceforth TAZ), [0074]

[Formula 36]



[0075] The 4 and 4'-bis(1 and 1-diphenyl ethenyl) biphenyl (DPVBi is also told to below.) shown in [-izing 36], [0076]

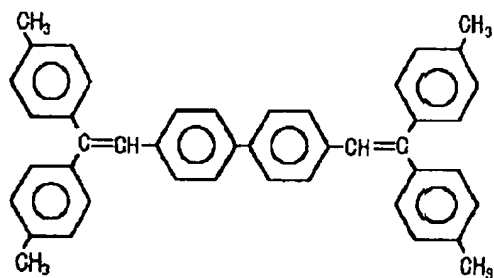
[Formula 37]



[0077] 2, 5-bis(1-naphthyl)-1.3.4-OKISA diazole (BND is also told to the below.) which are shown in [-izing 37]

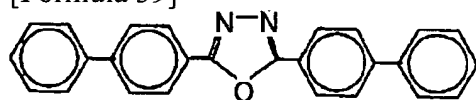
[0078]

[Formula 38]



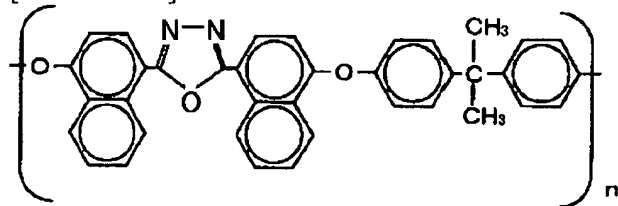
[0079] The 4 and 4'-bis(1 and 1-bis(4-methylphenyl) ethenyl) biphenyl (it is also called Following DTVBi.) shown in [-izing 38], [0080]

[Formula 39]



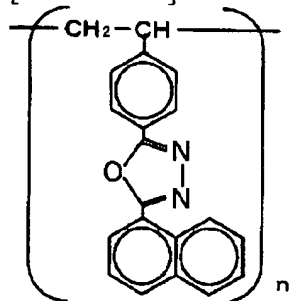
[0081] 2, 5-screw (4-biphenyl) which are shown in [-izing 39] - 1, 3, 4-OKISA diazole (it is also called Following BBD.), [0082]

[Formula 40]



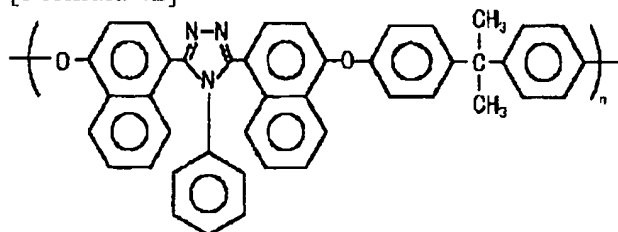
[0083]

[Formula 41]

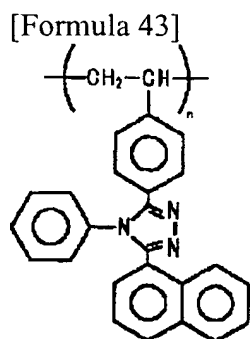


[0084] An OKISA diazole system high molecular compound as shown in [-izing 40] and [-izing 41], [0085]

[Formula 42]



[0086]

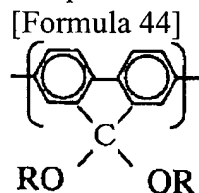


[0087] A triazole system high molecular compound as shown by [-izing 42] and [-izing 43] etc. can be mentioned.

[0088] Moreover, the electronic transportation layer 60 is a layer for conveying the electron poured in from catholyte 70, and contains an electronic transportation agent. The configuration which consists of electronic transportability macromolecules and contains an electronic transportability low-molecular further is possible for an electronic transportation agent.

[0089] PBD shown in [-izing 32] as an electronic transportability low-molecular example here, Alq3 shown in [-izing 34], TAZ shown in [-izing 35], DPVBi shown in [-izing 36], BND shown in [-izing 37], DTVBi shown in [-izing 38], BBD shown in [-izing 39] can be mentioned.

[0090] Moreover, a triazole system high molecular compound as shown as an example of an electronic transportability giant molecule by the OKISA diazole system high molecular compound as shown by [-izing 40] and [-izing 41], [-izing 42], and [-izing 43], [0091]



[0092] (R shows the substituent constituted from C, H, O, and N among a chemical formula [-izing 44].)

The poly fluorene compound which repeats [-izing 44] and it has in a unit is mentioned.

[0093] The component structure shown in drawing 2 thru/or drawing 4 is possible as what added modification to the basic structure of the organic electroluminescent element shown in drawing 1 because of the further improvement in luminous efficiency, or the simplification of structure.

[0094] The component structure of the organic electroluminescent element shown by drawing 2 shows the 1st operation gestalt of the organic electroluminescent element of this invention.

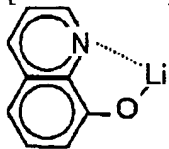
Although the electronic block layer 30 and the electron hole block layer 50 of drawing 1 are omitted, in drawing 2, an electronic block effect can be given to the electron hole transportation layer 20, an electron hole block effect can be given to the electronic transportation layer 60, respectively, and luminous efficiency can be maintained.

[0095] The component structure of the organic electroluminescent element shown by drawing 3 omits the electronic block layer 30 in the component structure shown by drawing 1.

[0096] From the component structure shown by drawing 1, the component structure of the organic electroluminescent element shown by drawing 4 omits the electronic block layer 30 and the electron hole block layer 50, and adds the electronic injection layer 61 constituted by the electron injectional matter between catholyte 70 and the electronic transportation layer 60.

[0097] As electron injectional matter, it is lithium fluoride, lithium oxide, and [0098], for example.

[Formula 45]



[0099] 8-hydroxyquinolinate lithium (it is also called Following Liq.) shown by [-izing 45] is mentioned.

[0100] Next, the manufacture approach of an organic electroluminescent element is explained for drawing 2 as 1st operation gestalt of this invention.

[0101] First, the anode plate layer 10 is formed in vacuum deposition or a spatter on the transperence insulation base material used as a substrate (not shown), for example, a glass substrate.

[0102] Next, the 1st solution which dissolved or distributed an electron hole transportability macromolecule or an electron hole transportability low-molecular to the solvent is created. Here, it is also possible to dissolve or distribute a binder macromolecule further in the 1st solution. And the electron hole transportation layer 20 is formed on the anode plate layer 10 with the wet method using the 1st solution.

[0103] Furthermore, the 2nd solution which dissolved or distributed the doping agent 41 and the host agent 42 of a luminous layer 40 to the solvent is created. Here, it is also possible to dissolve or distribute a binder macromolecule further in the 2nd solution. And a luminous layer 40 is formed on the above-mentioned electron hole transportation layer 20 with the wet method using the 2nd solution.

[0104] Furthermore, the 3rd solution which dissolved or distributed an electronic transportability macromolecule or an electronic transportability low-molecular to the solvent is created. Here, it is also possible to dissolve or distribute a binder macromolecule further in the 3rd solution. With the wet method using the 3rd solution, the electronic transportation layer 60 is formed on a luminous layer 40.

[0105] Moreover, the solubility parameter of the solvent used for the 2nd solution has the value which shows the outside of the meltable range to the matter (an electron hole transportability macromolecule, electron hole transportability low-molecular, etc.) contained in the electron hole transportation layer 20 in the membrane formation temperature of a luminous layer 40. In formation of the luminous layer 40 by the wet method using such a solvent, the organic substance contained in the lower layer electron hole transportation layer 20 is not dissolved.

[0106] For example, the solubility parameters which show this meltable range of PVK are or less more than $8.9(\text{cal}/\text{cm}^3)^{1/2}$ to $10.0(\text{cal}/\text{cm}^3)^{1/2}$ in a room temperature at the time of PVK which the organic substance contained in the electron hole transportation layer 20 shows to electron hole transportability macromolecule slack and [-izing 3]. Therefore, if the solvent of this solubility parameter which exists out of range is used as a solvent used for the 2nd solution, a luminous layer 40 can be formed, without dissolving PVK contained in the electron hole transportation layer 20. As an example of such a solvent, a xylene (a solubility parameter is $8.8(\text{cal}/\text{cm}^3)^{1/2}$), ethylbenzene (a solubility parameter is $8.7(\text{cal}/\text{cm}^3)^{1/2}$), 2-nitropropane (a solubility parameter is $10.1(\text{cal}/\text{cm}^3)^{1/2}$), a cyclohexane (a solubility parameter is $8.2(\text{cal}/\text{cm}^3)^{1/2}$), etc. are mentioned. Moreover, the solubility parameter of the solvent used for the 3rd solution has the value which shows the outside of the meltable range to the matter (a doping

agent 41, the host agent 42, binder macromolecule, etc.) contained in a luminous layer 40 in the membrane formation temperature of the electronic transportation layer 60. In formation of the electronic transportation layer 60 by the wet method using such a solvent, the organic substance contained in the lower layer luminous layer 40 is not dissolved.

[0107] For example, the doping agent 41 contained in a luminous layer 40 is OXD-1 shown in [Figure 15], the host agent 42 is Ir (ppy)₃ shown in [Figure 3], and when using Pori (4-vinyl biphenyl) as a binder giant molecule, the solubility parameters which show the meltable range of the organic substance which constitutes these luminous layers are or less more than 8.7(cal/cm³)^{1/2} in a room temperature. Therefore, if the solvent of this solubility parameter which exists out of range is used as a solvent used for the 3rd solution, the electronic transportation layer 60 can be formed, without dissolving the organic substance contained in a luminous layer 40. n-nonane (solubility parameter 7.64(cal/cm³)^{1/2}), 1-decene (solubility parameter 7.85(cal/cm³)^{1/2}), a methylcyclohexane (solubility parameter 8.13(cal/cm³)^{1/2}), a cyclohexane (solubility parameter 8.20(cal/cm³)^{1/2}), 1-chloropropane (solubility parameter 8.30(cal/cm³)^{1/2}), an acetonitrile (solubility parameter 11.8(cal/cm³)^{1/2}), etc. are mentioned as such an example of a solvent.

[0108] At this time, when the solvent used for the above-mentioned 1st thru/or the 3rd above-mentioned solution evaporates by the air drying, the electron hole transportation layer 20, a luminous layer 40, and the electronic transportation layer 60 are formed. In this case, it is not necessary to process heating, the polymerization by the exposure of ultraviolet rays, hardening, etc., therefore a production process is easy and can raise productive efficiency.

[0109] The usual coating methods, such as for example, the casting method, the blade coat method, a dip coating method, a spin coat method, a spray coating method, a roll coating method, and an ink jet coating method, are included in the wet method used by this invention.

[0110] Finally, vacuum deposition etc. is used, catholyte 70 is formed on the electronic transportation layer 60, and the organic electroluminescent element of this invention is obtained.

[0111] In addition, solubility parameter SP is defined by $SP = \{(\Delta H - RT) / V\}^{1/2}$ in the absolute temperature T of the liquid of molar-heat-of-vaporization ΔH and molar volume V. However, SP is a solubility parameter (unit: (cal/cm³)^{1/2}) among the above-mentioned formula, ΔH is the molar heat of vaporization (unit: cal/mol), R is a gas constant (unit: cal/(mol·K)), T is absolute temperature (unit: K), and V is molar volume (unit: cm³/mol).

[0112] Moreover, drawing 3 is the 2nd operation gestalt of the organic electroluminescent element of this invention. Before formation of the electronic transportation layer 60 among the production process of the component structure shown by above-mentioned drawing 2 Pass the production process which carries out sequential formation of the electronic transportation layer 60 and the catholyte 70 like above-mentioned drawing 2 on this electron hole block layer 50 after forming electron hole block nature matter, such as PBD, with a wet method and forming the electron hole block layer 50 on a luminous layer 40.

[0113] Moreover, drawing 4 should be the 3rd operation gestalt of the organic electroluminescent element of this invention, and among the production process of the component structure shown by above-mentioned drawing 2 , after it forms electron injectional matter, such as lithium fluoride, with vacuum deposition and forms an electronic injection layer 61 on the electronic transportation layer 60 before formation of catholyte 70, pass the production process which forms catholyte 70 like above-mentioned drawing 2 on this electronic injection layer 61.

[0114]

[Example] PVK6mg of the polystyrene equivalent weight normal (henceforth molecular weight) 1,100,000 measured with the [example 1] gel par EISHON chromatography was dissolved by 1ml 1,2-dichloroethane, and the solution 1 was created.

[0115] 0.4mg was dissolved in xylene 1ml as an iridium complex compound shown by 2.5mg and [-izing 22] in the polyvinyl biphenyl of molecular weight 115,000 as 2.5mg and a binder giant molecule as OXD-1, and the solution 2 was created.

[0116] The 50nm electron hole transportation layer was obtained by carrying out the spin coat of the solution 1 in rotational frequency 1000rpm and 1 second on the ITO substrate (below Marketing ITO, and :20ohms / by Asahi Glass Co., Ltd., and **) which performed oxygen plasma treatment.

[0117] Furthermore, the 20nm luminous layer was obtained by carrying out the spin coat of the solution 2 in rotational frequency 1000rpm and 1 second on an electron hole transportation layer.

[0118] Alq3 was formed [in evaporation rate 1 nm/sec] with the ten to 3 Pa degree of vacuum as an electronic transportation layer with the vacuum evaporation system at 50nm thickness, vapor codeposition of aluminum and the lithium was carried out at the rate of evaporation rate 1 nm/sec so that a lithium might become 1%, cathode was formed in the last, and the component structure shown in drawing 2 was created.

[0119] At this time, green luminescence of 550 cd/m2 (brightness: in a [example], it is below the same) was obtained by 9V (driver voltage: in a [example], it is below the same.), and 1 mA/cm2 (current density: in a [example], it is below the same).

[0120] They are 2.5mg and Ir (ppy)3 (in a chemical formula [-izing 1] R1 thru/or all R8 to the thing of hydrogen) as example of [comparison 1] OXD-1. it corresponds. It carries out and is 0.17mg (it is equivalent to the saturated concentration to the xylene of Ir (ppy)3.). The component structure shown in drawing 2 like [an example 1] was created except having dissolved polyvinyl biphenyl 2.5mg of molecular weight 115,000 in xylene 1ml as a binder giant molecule, and having created the solution 2.

[0121] At this time, green luminescence of 480 cd/m2 was obtained by 9V and 1 mA/cm2.

[0122] Since Ir(ppy) 3 dissolves in a xylene only ml only in 0.17mg /, this shows that the amount of dopes which can be contained in a luminous layer decreased, and the engine performance fell.

[0123] It changed to the iridium complex compound shown by [examples 2-8] and [-izing 22], and except having used the iridium complex compound using the substituent shown in the methoxyl group (CH3O-) part of [-izing 22] as R in following [table 1], when the component structure shown in drawing 2 like [an example 1] was created, luminescence of the luminous efficiency shown in [Table 1] was obtained.

[0124]

[Table 1]

| 実施例 | R | 1 mA / c m ² での性能 | |
|-----|------------------------------------|------------------------------|-------------------------|
| | | 電圧 (V) | 輝度 (cd/m ²) |
| 2 | -CH ₃ | 8.8 | 550 |
| 3 | -C ₂ H ₅ | 9.0 | 550 |
| 4 | -C(CH ₃) ₃ | 9.2 | 540 |
| 5 | -C ₆ H ₁₇ | 9.3 | 560 |
| 6 | -OC ₂ H ₅ | 9.0 | 500 |
| 7 | -OC(CH ₃) ₃ | 9.4 | 490 |
| 8 | -O C ₈ H ₁₇ | 9.4 | 510 |

[0125] The component structure shown in drawing 2 like [an example 1] was created except having used the iridium complex compound shown by [-izing 23] instead of the iridium complex

compound shown by [the example 9] and [-izing 22].

[0126] At this time, luminescence of 550 cd/m² was obtained by 8.7V and 1 mA/cm².

[0127] As a [example 10] luminous layer doping agent, the component structure shown in drawing 2 like [an example 1] was created instead of the iridium complex compound shown by [-izing 22] except having used the 2, 3, 7, 8, 12, 13, 17, 18-OKUTA ethoxy-21H, and 23H-porphin platinum (II) shown by [-izing 31]. At this time, luminescence of the red of 200 cd/m² was obtained by 9V and 10 mA/cm².

[0128] The component structure shown in drawing 2 like [an example 1] was created except having changed to Alq₃ as [example 11] electronic transportability matter, and having used OXD-1. At this time, green luminescence of 520 cd/m² was obtained by 8.5V and 1 mA/cm².

[0129] The component structure shown in drawing 3 like [an example 1] was created except having carried out vacuum deposition of the CBP as an electron hole block layer between the [example 12] luminous layer and the electronic transportation layer by the ten to 3 Pa degree of vacuum, and evaporation rate 0.1 nm/sec, and having formed membranes to 6nm thickness.

[0130] At this time, green luminescence of 560 cd/m² was obtained by 9.2V and 1 mA/cm².

[0131] Between a [example 13] electronic transportation layer and cathode, as an electronic injection layer, vacuum deposition of the lithium fluoride was carried out by the ten to 4 Pa degree of vacuum, and evaporation rate 0.1 nm/sec, membranes were formed at 5nm thickness, and the component structure shown like [an example 1] at drawing 4 was created except having changed the ingredient of catholyte to aluminum.

[0132] At this time, green luminescence of 520 cd/m² was obtained by 8.7V and 1 mA/cm².

[0133] It changed to PVK as an ingredient of a [example 14] electron hole transportation layer, and the component structure shown in drawing 2 like [an example 1] was created except having used the poly carbazole compound which repeats the [-izing 7] of molecular weight 60,000, and it has as a unit.

[0134] This time, green luminescence of 530 cd/m² was obtained by 7.8V and 1 mA/cm².

[0135] 6mg was dissolved by 1ml 1,2-dichloroethane as PVK of the [example 15] molecular weight 1,000,000, and the solution 1 was created.

[0136] 0.4mg was dissolved in xylene 1ml as an iridium complex compound shown by 2.5mg and [-izing 22] as a polyvinyl biphenyl of 2.5mg and molecular weight 115,000 as OXD-1, and the solution 2 was created.

[0137] Polystyrene 2.5ml of molecular weight 1,000 was dissolved in cyclohexane 1ml as 2.5mg and a binder giant molecule as PBD, and the solution 3 was created.

[0138] The electron hole transportation layer of 50nm film pressure was obtained by carrying out the spin coat of the solution 1 on the ITO substrate (below Marketing ITO, and :20ohms / by Asahi Glass Co., Ltd., and **) which performed oxygen plasma treatment.

[0139] The 20nm luminous layer was obtained by carrying out the spin coat of the solution 2 on an electron hole transportation layer.

[0140] Furthermore, the 50nm electronic transportation layer was obtained by carrying out the spin coat of the solution 3 on a luminous layer.

[0141] With the vacuum evaporation system, the component structure which carries out vapor codeposition of aluminum and the lithium at the rate of evaporation rate 1 nm/sec with a ten to 3 Pa degree of vacuum so that a lithium may become 1%, forms cathode, and is shown at drawing 2 was created at the last.

[0142] At this time, it was green luminescence of 540 cd/m² in 9.2V and 1 mA/cm².

[0143] [Example 16] The component structure shown in drawing 2 like [an example 15] was

created except having dissolved 5mg (molecular weight 60,000) of polymers of the poly carbazole compound which repeats [-izing 7] and it has as a unit in dichloroethane 1ml, and having created the solution 1.

[0144] At this time, green luminescence of 540 cd/m² was obtained by 8.2V and 1 mA/cm².

[0145] The component structure shown in drawing 2 like [an example 16] was created except having dissolved in 5mg (molecular weight 60,000) of polymers of the poly fluorene compound which set R to -C₈H₁₇ in [an example 17] and [-izing 44] and which has a unit repeatedly at cyclohexane 1ml, and having created the solution 3.

[0146] At this time, green luminescence of 520 cd/m² was obtained by 7.5V and 1 mA/cm².

[0147] The component structure shown in drawing 2 like [an example 17] was created except having changed the solvent of the [example 18] solution 2 into nitropropane from the xylene.

[0148] At this time, green luminescence of 500 cd/m² was obtained by 7.8V and 1 mA/cm².

[0149]

[Effect of the Invention] In case it is formed by the wet method, since the luminous layer of the solution condition containing a comparatively high-concentration doping agent is used for the organic electroluminescent element of this invention, it can obtain luminescence of high brightness, so that clearly from the above explanation.

[Translation done.]